SUMMARY

This Programmatic Environmental Impact Statement (PEIS) has been prepared for the Puget Sound Confined Disposal Site Study, an interagency effort led by the U.S. Army Corps of Engineers (Corps) and the Washington Departments of Ecology (Ecology) and Natural Resources (DNR). Other participating state and federal agencies and organizations include Puget Sound Water Quality Action Team (PSWQAT), Washington Public Ports Association, and Region 10 of the U.S. Environmental Protection Agency (EPA).

The objective of this PEIS is to provide a broad initial environmental review and cost analysis of major alternatives for the confined disposal and treatment of contaminated sediments dredged from Puget Sound, Washington. Pending the outcome of this evaluation of alternatives, a site-specific EIS in support of a specific confined disposal or treatment alternative may be pursued in that region of Puget Sound that might benefit most from such an effort. The long-term goal of this effort is to address the regional need for disposal or treatment of contaminated sediments that require dredging. The alternatives evaluated at a programmatic level include the following:

- No action
- Disposal in constructed confined aquatic, nearshore, or upland multiuser disposal sites (presented as three individual alternatives, one for each disposal environment)
- Disposal in existing solid waste landfills
- Multiuser disposal in large, privately-developed, confined disposal projects
- Sediment Treatment (Decontamination)
- Combinations of alternatives.

AUTHORITY AND JURISDICTION

This PEIS was prepared pursuant to the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA) to support federal, state, and local decision making in regards to the confined disposal of contaminated sediments. The Corps, Seattle District, is the NEPA lead agency for this project, and Ecology and DNR are the co-lead SEPA agencies.

The Corps has regulatory authority over many activities affecting the waters of the United States. This authority is derived from both Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (1977). A Section 10 permit is required for dredging operations of any kind whether for navigation or environmental cleanup. A Section 404 permit is required for discharges of dredged or fill material into waters of the U.S. including wetlands. This includes upland disposal environments when there is return flow (e.g., runoff) to the waters of the U.S.

For any federally permitted project that requires a Section 10/404 permit, Ecology has authority through Section 401 of the Clean Water Act to issue a water quality certification. A Section 401 certification is a precondition to receiving a Section 404 permit and is designed to ensure that the proposed action does not violate any applicable federal and state water quality criteria.

The dredging, confined disposal and/or treatment of contaminated sediments in Puget Sound also would need to comply with other state and local laws and regulations. In addition to the other agency study members (EPA, DNR, and PSWQAT), participating agencies and groups that might have authority over activities described in this PEIS, depending on the alternative and geographic location, include the following:

- U.S. Department of the Interior, Fish and Wildlife Service
- U.S. Department of Commerce, NOAA, National Marine Fisheries Service
- Washington Department of Fish and Wildlife
- City and county governments
- Native American Tribes
- Local health departments

PURPOSE AND NEED

The dredging of sediments from shipping channels and berths to maintain or deepen navigable water depths, from waterfront development and habitat restoration projects, and from aquatic site cleanup projects, results in a need to safely handle and dispose or treat dredged material that is unsuitable for unconfined, open-water disposal. These contaminated sediments require confined disposal or treatment to eliminate or minimize the risk of short- and long-term contaminant release to the environment.

To date in Puget Sound, dredging and disposal of contaminated sediments have been done on a project-by-project basis. The contaminated sediment dredging and disposal process can be time-consuming, expensive, uncertain, and often controversial for dredging proponents, regulators, and the public. Efforts to clean up contaminated sediments have also been hindered by the lack of viable confined disposal or treatment options and the time required to obtain project approval from permitting agencies. Thus, the overall goal of the Puget Sound Confined Disposal Site Study is to find environmentally sound and affordable solutions for the confined disposal and/or treatment of contaminated sediments.

Based on existing information, the volume of contaminated sediment in Puget Sound that will be dredged over the next 15 years, is projected to be between about 6 and 13 million cubic yards (cy). Subtracting the volume of sediment that will likely be cleaned up before a multiuser disposal or treatment facility could become available, from 3 to 7 million cy of contaminated dredged material from Puget Sound will require confined disposal or treatment. These estimates include sediment from contaminated site cleanup projects, navigation and maintenance dredging, waterfront development, and habitat restoration projects.

The majority of the contaminated sediments are located in Puget Sound's south-central urban/industrial embayments. Considering all existing sites, about 41% of the contaminated sediment volume is located in the Elliott Bay/Seattle/Lake Washington area (including the Ship Canal and Lake Union). Another 30% is found in Commencement Bay and about 18% is in the Bellingham Bay region. The remaining relatively minor volumes are found in Sinclair Inlet/Bremerton (5%), Port Gardner/Everett (4%) and Budd Inlet/Olympia (1%). Because the Sinclair Inlet area is geographically close to the Elliott Bay region, about half of Puget Sound's contaminated sediments are situated in this central Puget Sound area. Three-quarters of the contaminated sediments are located in the area bounded by Seattle, Tacoma, and Bremerton. This is the region with the greatest contaminated sediment disposal need and the logical focus for a site-specific confined disposal EIS.

As existing contaminated areas (which can be sources of contamination to adjacent areas) are cleaned up and as improved source control efforts continue to be implemented throughout Puget Sound, it is reasonable to assume that the input of contaminants to Puget Sound will decrease over the study's planning horizon. Natural processes such as sedimentation (burial) and chemical and biological degradation should also reduce contaminant levels in surface sediments over time. Consequently, a long-term decrease in contaminated sediment disposal or treatment needs may be observed as the contaminated volumes identified above are addressed. Alternatively, delays in on-going cleanup actions and/or the adoption of more restrictive sediment cleanup standards could increase long-term contaminated sediment disposal or treatment needs.

ALTERNATIVES

Seven alternatives (including no-action) for the confined disposal of contaminated sediments from Puget Sound were identified by the study team. An eighth alternative, sediment treatment, was added to this final PEIS in response to increased awareness by the Study Team of recent research and development in this field and public comments on the draft PEIS. The major features of each alternative are described below. The constructed alternatives for multiuser disposal sites (MUDS), [level bottom capping and contained aquatic disposal, nearshore and upland confined disposal facilities (CDF)s] and the use of existing solid waste landfills are defined in the PEIS in sufficient detail to allow evaluation and comparison of their potential environmental impacts and costs. Much of this detail was based on information provided by the Corps' Waterways Experiment Station specifically for this study (Palermo et al. 1998a).

To allow evaluation of the constructed alternatives in this programmatic EIS, it was necessary to make assumptions about the design, shape, layout, capacity, and operational life of each alternative. For each constructed alternative, a conceptual design was developed and both 500,000-cy and 2,000,000-cy facilities were considered. Also, each facility was assumed to be operational (i.e., accept contaminated dredged material) for a 10-year period. It is important to note, however, that other realistic design and operational options exist. For example, a MUDS could have more than a 2,000,000-cy capacity and be in operation for more than 10 years. So while this PEIS presents and evaluates plausible scenarios for a Puget Sound MUDS, other reasonable scenarios could emerge during site-specific efforts.

No-action

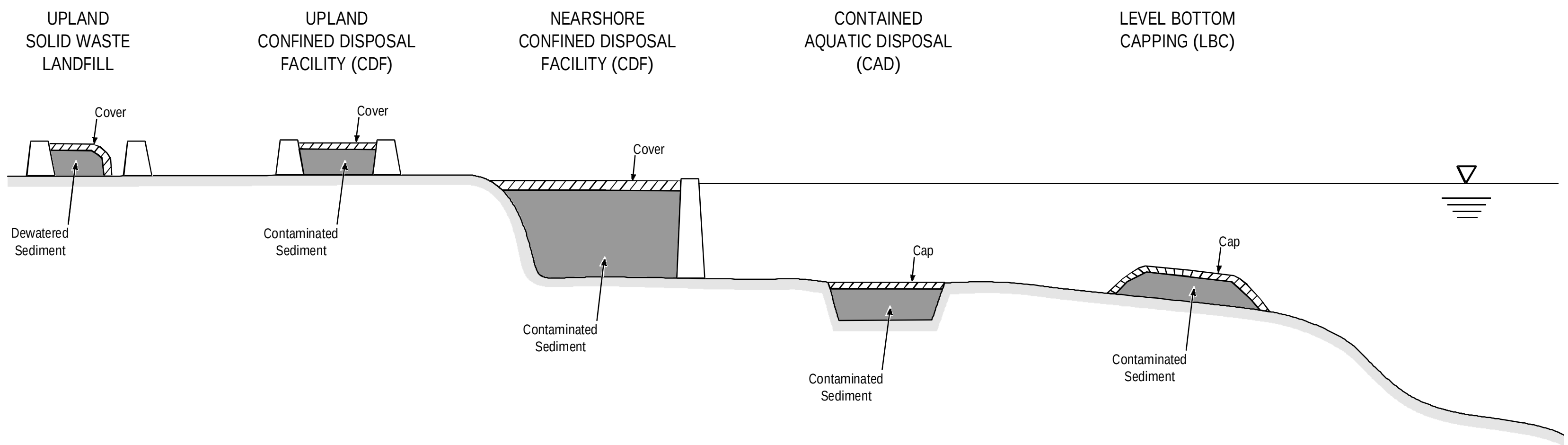
Under the no-action alternative, no multiuser disposal or treatment facility would be established. Contaminated sediment cleanup and dredged material disposal would continue as it is currently done. Confined disposal facilities would be developed by individual users on a project-by-project basis, some contaminated dredged material would likely be disposed in existing landfills, and some contaminated sediments would be left in-place and exposed to the environment until remedial action or dredging was required. These actions would likely be conducted under the existing framework of regulations and options. In addition, changes to existing policies or regulations might be pursued (i.e., even in the absence of additional confined disposal studies) to facilitate contaminated sediment disposal or cleanup. Examples of such changes are discussed briefly under the no-action alternative.

The following three alternatives are considered the main constructed alternatives because they include disposing of contaminated sediments in a constructed confined disposal facility (Figure S-1). For environmental impact evaluation, feasibility, and costing purposes, it is assumed that each constructed facility would have a 10-year operational life and both 500,000- and 2,000,000-cy capacity sites are considered.

Level Bottom Capping (LBC) and Contained Aquatic Disposal (CAD)

LBC and CAD are two types of underwater sediment disposal that are discussed as one alternative because they have similar features and potential environmental impacts. LBC is the placement of contaminated material in a mound on an existing flat or very gently sloping natural bottom and covering the mound with clean sediments. The cap isolates the marine environment from the contaminated material and minimizes the potential for contaminant migration. Biological communities recolonize these areas following final cap placement.

CAD is similar to LBC but includes some form of lateral confinement (e.g., placement in natural or excavated bottom depressions or behind berms) to minimize spread of the materials on the bottom (see Figure S-1). CAD is generally used where the bottom conditions (e.g., slopes) require lateral control measures to limit the spread of the contaminated sediments.



SOURCE: Based on Palermo et al. 1998a

Figure S-1	Conceptual Illustration of Confined Disposal Alternatives	MUDS Final PEIS	
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Both LBC and CAD include dredging of contaminated sediments from one or more locations, transportation to the disposal site, and accurate placement of the contaminated materials at the site. LBC sites have been successfully constructed on relatively flat bottoms (0-1%) in depths up to about 200 ft (Wiley 1995, SAIC 1998). CAD sites are generally constructed in water depths less than or equal to 100 ft, but can be constructed in areas with slopes up to 6%. Given the relatively steep slopes that are characteristic of the shallower depths in much of Puget Sound, the CAD option was considered a more likely aquatic disposal scenario and was therefore developed as the aquatic alternative conceptual design in this PEIS. However, this does not preclude consideration of a LBC design as part of future site-specific confined disposal efforts if suitable site conditions exist.

The dredging, disposal, and monitoring technologies associated with LBC/CAD facilities are established. The effectiveness of an LBC/CAD facility in avoiding or minimizing environmental risks is a function of appropriate site location, design and construction, technology and operational controls, and effective short- and long-term monitoring and site closure. Two successful CAD projects have been completed in Puget Sound. In others areas of the U.S. and throughout the world, numerous effective CAD and LBC sites have been constructed.

For this PEIS, the conceptual design for this alternative consists of series of CAD pits that are excavated, backfilled with contaminated sediments, and capped with clean sediments (one CAD pit per year over the 10-year operational life). Cost estimates for disposal at the conceptual CAD site described in this PEIS range from $15/cy to $21/cy (exclusive of dredging and transport costs to the CAD site and land acquisition costs).

Nearshore Confined Disposal Facility

Nearshore confined disposal is the placement of contaminated dredged material at a site constructed partially or completely in water adjacent to shore, where the dredged material is contained by a dike or berm (see Figure S-1). Nearshore sites use the shoreline as part of the containment structure, with in-water dikes constructed out from the shoreline to complete the enclosure. Once the contaminated material filling the diked area reaches a specified elevation, it is capped with clean material. The clean capping material raises the elevation to just below or at dike level. The nearshore sites can be finished to grade to allow beneficial reuse or development of the created uplands after completion. Alternatively, they can be finished to grade in the intertidal zone to create intertidal or shallow subtidal habitat.

The construction, dredging, disposal, and monitoring technologies associated with nearshore disposal facilities are established. Three nearshore CDFs for contaminated sediments have been successfully constructed in Puget Sound in recent years. The effectiveness of a nearshore site in minimizing environmental risks is a function of appropriate site location, design and construction, operational controls, and effective long-term monitoring and site closure. The three Puget Sound CDFs, initially constructed in water, have become useful upland areas (e.g., container terminals) following final capping and closure.

The disposal cost estimates for nearshore CDF conceptual design described in this PEIS range from $28/cy to $46/cy (exclusive of dredging and barge transport costs to the CDF).

Upland Confined Disposal Facility (including a Dewatering Facility)

The upland CDF alternative is the placement of contaminated sediments within a diked confinement structure. The contaminated sediments are covered with clean material to allow beneficial reuse after completion (see Figure S-1). Upland CDFs are designed to retain dredged sediment solids while providing acceptable suspended solids and/or contaminant concentrations in effluent for discharge to receiving waters. All dredged material at upland CDFs is placed above the water table.

Although there are currently no upland CDFs for contaminated sediments in the Puget Sound area, nationally, upland CDFs are one of the most common dredged material disposal methods. Upland CDFs are found throughout much of the country and are extensively used in the Atlantic and Gulf Coast regions of the U.S.

The technologies associated with constructing and disposing of sediments in an upland CDF are similar to solid waste landfill technologies (see below). In this PEIS, it was assumed that water content of the dredged sediments for disposal at both the upland CDF and solid waste landfill alternatives is reduced before disposal to minimize water management requirements at the facilities. The upland conceptual design includes dewatering of the contaminated sediments at a separate rehandling facility that is accessed from the water before transport and final placement at the upland CDF.

The dewatering facility is comprised of multiple cells where material can be actively disposed of, left for dewatering, rehandled for transport to the upland disposal site, or used to store excess sediments. Individual cells are lined or paved to control leachate infiltration into the groundwater, depending on regulatory requirements and the level of sediment contamination. Dikes of compacted soil or concrete provide the outside walls and separate the dewatering facility into individual cells. All water within the dewatering operations area is collected and treated to meet state and local water quality requirements before discharge back to surface waters.

The estimated costs for disposal at an upland CDF, including dewatering at specially established rehandling facilities, range from $49 to $67/cy (exclusive of dredging and transport costs to the dewatering facility).

Disposal in Existing Solid Waste Landfills

The solid waste landfill alternative is the placement of contaminated sediments within an existing upland solid waste landfill. Solid waste landfills in the state of Washington are regulated primarily by the Minimum Functional Standards For Solid Waste Handling (WAC 173-304), Criteria For Municipal Solid Waste Landfills (WAC 173-351), and the Resource Conservation and Recovery Act (RCRA) (Subtitle D). These regulations were established by state and federal governments to ensure protection of human health and the environment.

Sediments must be dewatered prior to transport to a landfill because of the water content in dredged material. Dewatering requires rehandling of the contaminated sediments at a facility that is accessed from the water and is typically included and permitted as part of a project dredging plan. Under this alternative, dewatering is done at a specially-constructed nearshore multiuser dewatering facility, as described in the upland CDF alternative.

The technologies for disposing of contaminated sediments in an existing solid waste landfill are established. The dewatered sediments are placed in lined containers for transport by truck or rail to a landfill. At the landfill, sediments are placed in an active cell for disposal or, if appropriate, used as daily cover material for other waste materials.

Private and public landfills currently operating in Washington and Oregon have accepted contaminated sediments for disposal. The two largest operating private landfills in the region are Roosevelt landfill in southern Washington, operated by the Regional Disposal Company of Rabanco, and Columbia Ridge landfill in northern Oregon, operated by Waste Management, Inc. In western Washington, county governments operate solid waste landfills for disposal of material generated within their jurisdictions. While many of these sites can accept dewatered contaminated sediments, the capacity of these landfills is limited. Because of the difficulty in siting new landfills near metropolitan areas, most Puget Sound basin jurisdictions are reluctant to accept a large volume of unanticipated material such as dewatered contaminated sediments.

The cost estimates for disposal at a solid waste landfill range from $49 to $66/cy. These estimates include dewatering, transport, and disposal at current landfill disposal costs for large quantities of material (i.e., 500,000- and 2,000,000-cy), but are exclusive of dredging and transport costs to the dewatering facility.

Multiuser Access to Privately-Developed Confined Disposal Projects

This alternative calls for access to larger confined disposal projects by users other than the project proponent. Project proponents have been reluctant to provide multiuser access to their disposal projects because of the following concerns:

- Extended time frames for site development and closure
- Lost capacity for their own disposal projects
- Inherited liability of accepting contaminated sediments from other parties.

The environmental issues associated with multiuser access to a confined disposal project would be the same as for a multiuser facility of the same type (e.g., nearshore or upland). Some differences between the multiuser disposal alternatives and this alternative would be how long the site would be open for disposal to accommodate multiple users, how the liability would be managed for multiple parties, and how the site would be managed and operated. These issues would need to be addressed as part of a project- and site-specific environmental review.

Treatment (Decontamination) Of Dredged Material

In recent years, significant progress has been made in assessing the feasibility (technology/economics) of decontaminating dredged material. On-going studies, particularly in the New York/New Jersey harbor region, have progressed from bench through pilot-scale testing for several contaminated sediment treatment processes and commercial scale (100,000+ cy/year) operations may be on-line in one to two years. For this PEIS, a review was conducted of these recent developments as well as other potentially applicable treatment technologies from other programs (e.g., ARCS and SITE) and regions.

Based on this review, sediment treatment is presented as a programmatic alternative for the Puget Sound Confined Disposal Site study. Treatment has the potential to become a component of a regional management strategy for contaminated dredged material. At this time, it is not possible to provide specific conceptual designs and discuss specific environmental consequences of a multiuser sediment treatment alternative. However, the range of potential features and the relative resource requirements, limitations, and advantages of promising sediment treatment processes can be described in general terms.

While sediment treatment could be a stand-alone alternative, it would more likely be part of a combination alternative that included a dewatering/rehandling facility, treatment, and upland disposal (either at an existing landfill or CDF) or end product (e.g, cement, light weight aggregate, manufactured topsoil) beneficial use.

The environmental pathways of concern associated with sediment treatment are fundamentally different from pathways associated with confined disposal. Sediment “treatment” can involve destruction or breakdown of the contaminants to non-hazardous forms using high temperature technologies or low temperature contaminant removal by chemical and/or physical methods. In these processes, contaminated side-streams may be created. These side-streams, which may be gas (vapor), liquid, or solid, must be effectively managed as part of the treatment process to insure that contaminants are not re-introduced into the environment. Other treatment technologies involve the binding of contaminants into the solids matrix.

The feasibility and cost-effectiveness of any treatment approach in Puget Sound will depend on factors such as the quantity of material to be treated over time, contaminant types and concentrations, the target post-treatment contaminant concentrations, and perhaps the potential end uses and marketability of the treated material. Based on the apparently successful demonstrations in the New York/New Jersey harbor region, sediment treatment has the potential to become a viable alternative for Puget Sound sediments in the near future. However, the total cost and feasibility of treatment must first approach the cost and feasibility of the confined disposal alternatives. Government and/or private sector funding of promising regional treatment approaches may be needed to develop treatment as a viable option in site-specific MUDS efforts.

Combination of Alternatives

A combination of two or more of the alternatives previously described is also an alternative. This alternative could be a hybrid composed of any of the action-based alternatives. For example, a CAD facility could be located adjacent to a nearshore CDF, or a location including both a nearshore CDF and shoreside rehandling/treatment facility could be developed. Siting and capacity criteria are critical elements in determining the feasibility of the combination alternative. Because a combination alternative would not be identified until after completion of the PEIS and initiation of the site selection process, the combination alternative is not directly evaluated in this PEIS. However, the environmental consequences and cost of any potential combination alternative can be assumed to be a composite of the consequences and costs of the individual alternatives.

IMPACTS AND MITIGATION

Table S-1 summarizes the potential impacts, mitigation, and unavoidable adverse impacts of each of the major alternatives. Impacts are associated with contaminant pathways and potential biological receptors. Mitigation involves controlling or minimizing the opportunities for contaminant release to the environment through effective siting, site design, technology and operational controls, site monitoring and management, and effective closure practices. Because the constructed alternatives involve the irretrievable commitment of aquatic, nearshore, and upland land resources to a sediment containment or treatment function, the siting process and decisions made during site-specific efforts will be critical in avoiding or minimizing significant impacts.

CONCLUSIONS

Need for a MUDS

This PEIS demonstrates a need to remove a large volume of moderately contaminated sediment from the greater Puget Sound and transfer it to one or more appropriate locations for disposal and/or treatment. Because of the large volume, experience with

Table S-1. Summary of Environmental Impacts by Alternative.

Alternative	Potential Impact	Mitigation	Unavoidable Adverse Impacts
No Action	- Proliferation of smaller and more confined disposal sites - Inefficiency in sediment evaluation, site design, and permitting process - Possible legal actions to protect aquatic life and endangered species	- Existing regulatory mechanisms for cleanup (e.g., CERCLA, SMS) - Individual project mitigation requirements of federal, state, and local entitities	- Delays in cleaning up contaminated sites and some maintenance dredging projects - Long-term exposure of contaminated surface sediments and continued harm to aquatic life and other biota
Contained Aquatic Disposal			
CAD Cell Excavation and Contaminated Sediment Placement	- Short-term exposure of biota to suspended solids, reduced dissolved oxygen (DO), dissolved contaminants, and particulate contaminants - Short-term aesthetic impact - Dispersal of contaminants - Long-term biological uptake by benthos, fish, and humans - Temporal loss of subtidal habitat - Destruction of sedentary benthos and displacement of mobile fauna	- Mechanically dredged, bottom-dumped material, and operational controls; use downpipe (tremie) placement, if needed - Water quality (WQ) monitoring to ensure compliance with appropriate water quality standards (WQS) and modify placement technique as needed - Avoid heavy public use areas in siting - Site in low energy areas, monitor accurate placement, tidal current windows - Place interim caps within 4 weeks of disposal, final cap of 3+ feet - Monitor bioaccumulation of shellfish and demersal fish in area - Avoid high resource areas in siting - Exclude critical or priority habitat areas in siting, monitor benthic recovery on cap - Pre-excavation benthic habitat assessment and, if needed, off-site mitigation - Compliance with dredging and disposal closure periods	- Minor amounts of sediment will settle outside of CAD cell
Cap Placement	- Short-term exposure of biota to suspended solids and reduced DO	- WQ monitoring to ensure compliance with appropriate WQS - Compliance with dredging closure periods	- None
Long-term Containment	- Cap erosion or disturbance and release of contaminants	- Site in low energy areas, adhere to land use restrictions (e.g., no anchor zone) - Effective cap design, placement, and verification - Long-term monitoring and cap replenishment, as needed	- Foreclosure of future use (e.g., navigation deepening)
Nearshore Confined Disposal Facility			
Site Preparation and CDF Construction	- Short-term exposure of biota to suspended solids and reduced DO - Loss of intertidal and shallow subtidal habitat and displacement of fauna - Long-term aesthetic impacts	- Runoff controls - WQ monitoring to ensure compliance with appropriate WQS - Pre-construction habitat assessment and habitat mitigation - Siting excludes critical or priority habitat and high value resource use areas - Siting preference for industrial/commercial area or contaminated sites	- Loss of nearshore habitat

Table S-1. Summary of Environmental Impacts by Alternative.

Alternative	Potential Impact	Mitigation	Unavoidable Adverse Impacts
Contaminated Sediment Placement and Redistribution	- Exposure of biota to contaminants in runoff/effluent discharge, leachate, seepage through dike, and air emissions (volatilization)	- Effective CDF siting, design, modeling, monitoring, and management - Ensure adequate dilution, determine and maintain effective fill rate - WQ monitoring to ensure compliance with appropriate WQS - Air quality monitoring to ensure compliance with standards - Maintain ponded water above sediments - Discourage access through fencing, cover, noise blasts - Periodic placement of interim caps, if warranted - Operational controls	- Uptake by foraging birds (gulls, waterfowl) - Long-term biological uptake by plants, birds, and mammals
Cap Placement	- Dispersal of contaminants	- Effective cap design, placement, and monitoring	- None
Long-term Confinement	- Mass release of contaminants due to catastrophic failure (e.g., major seismic event)	- Effective siting design, construction, monitoring, and management contingency plans	- Localized aesthetic impacts (e.g., noise, odor, view) - Minor long-term release of contaminants in effluent and seepage
Upland Dewatering Facility and Confined Disposal Facility			
Site Preparation and CDF Construction	- Short-term exposure of biota to suspended solids and sedimentation of streams - Loss of upland habitat	- Sedimentation ponds and runoff controls - WQ monitoring to ensure compliance with appropriate WQS - Avoid construction during storm events - Siting excludes critical habitat, wetlands, parks, preserves - Perform pre-construction habitat assessment - Siting excludes residential areas and recreational areas	- None
Dewatering and Disposal at Upland CDF	- Exposure of biota to contaminants in runoff/effluent from dewatering leachate at CDF - Volatilization from sediments - Contaminated dust dispersal - Long-term biological uptake by plants, birds, and mammals	- Collection and filtration of runoff/effluent - WQ monitoring to ensure compliance with appropriate WQS - Siting and design meets landfill minimum functional standards - Avoid sole-source aquifers; include CDF liners, leachate collection and treatment system, monitoring wells - Place interim covers, as needed, erect wind barriers - Compliance with air quality standards - Spray dust suppressant, as needed - Fencing, sound blasts, interim covers, as needed	- None

Table S-1. Summary of Environmental Impacts by Alternative.

Alternative	Potential Impact	Mitigation	Unavoidable Adverse Impacts
Long-term Confinement at Upland CDF	- Exposure of biota to dissolved contaminants and particulate contaminants - Groundwater contamination - Mass release of contaminants due to catastrophic failure (e.g., major seismic event)	- Monitor integrity of final cover - Siting and design; avoid sole-source aquifers - Monitor groundwater and develop contingency plan - Contingency plans	- Localized aesthetic impacts (e.g., noise, odor, view) - Some leachate leakage inevitable - Loss of upland habitat and alternative land uses
Disposal in Existing Solid Waste Landfills			
Dewatering and Overland Transport by Truck or Rail	- Exposure of biota to contaminants in runoff/effluent from dewatering - Volatilization from sediments - Contaminated dust dispersal - Spills/release during transport	- Collection and filtration of runoff/effluent - WQ monitoring to ensure compliance with appropriate WQS - Cover as needed and erect wind barriers to ensure compliance with air quality standards - Use lined rail cars or truck beds	- None
Long-term Confinement at Existing Landfill	- Exposure of biota to dissolved contaminants and particulate contaminants - Groundwater contamination - Mass release of contaminants due to catastrophic failure (e.g., major seismic event)	- Facility meets Minimum Functional Standards for Solid Waste Handling (WAC 173-304) - Siting and design; avoid sole-source aquifers - Contingency plans	- Localized aesthetic impacts (e.g., noise, odor, view)
Multiuser Access to CDF	- Impacts, mitigation, and unavoidable adverse impacts would be consistent with those at a multiuser CDF (nearshore or upland)		
Sediment Treament (Specific impacts, mitigation dependent on site-specific sediment handling, treatment process, and end product re-use)	- Release of contaminants in waste side-streams (surface water/air quality) - Potential generation of hazardous substance	- Effective control/monitoring of side-streams - Strict operational controls and process monitoring - Siting and design - Contingency plans	- Loss of alternative upland land uses
Combination of Alternatives	- Impacts, mitigation, and unavoidable adverse impacts would be dependent on project and site specific combination		

existing confined disposal alternatives, and the current regulatory climate, this could logically lead to building a MUDS facility and continuing to transport some of the sediment to existing solid waste landfills.

Puget Sound and adjacent areas, such as Lake Union and Lake Washington, contain between four and eleven million cubic yards of sediment that are designated "contaminated", either by federal and/or state standards. The sediments that pose unacceptable risks to the environment or human health, and that cannot be capped in place or otherwise isolated, will need to be dredged. Current disposal options are limited to regional solid waste landfills, and to in-water sites chosen specifically as part of cleanups performed under CERCLA, MTCA or the Clean Water Act. However, there is general agreement that far too much aquatic and terrestrial habitat has been lost or degraded during the past, and that continued exposure of endangered salmonids and their prey to contaminated sediment is not consistent with recovery strategies for these species. Within the next 10-20 years, this volume of contaminated sediment needs to be dredged and either confined in some manner, treated, or else beneficially reused.

A large fraction of the total volume of contaminated sediment identified under existing regulatory programs, such as CERCLA and MTCA, may be capped or dredged and placed in single-user confined disposal facilities by the time a MUDS facility can be built. However, when the remaining cleanup volume, one to five million cubic yards, is combined with other sources of contaminated sediment (e.g., maintenance dredging material), there is still adequate volume, from three to seven million cubic yards, to justify siting and building at least one MUDS facility.

It is also important to note that single-user, single-project sediment caps and confined aquatic disposal facilities already exist in the Puget Sound. Constructing a single-user disposal facility can be beneficial to planned cleanup actions and can be a viable alternative for responsible parties with adequate financial resources.

A cost-competitive MUDS facility is needed to ensure timely actions to remove and isolate contaminated sediments in the future. The potential adverse impacts to aquatic and/or terrestrial habitats from building a MUDS facility can be less than those associated with building many single-user disposal facilities. Fewer disposal sites located on State owned aquatic or terrestrial lands, or any other lands, can minimize concerns over long-term liability associated with disposal of contaminated sediment. Because single-user disposal facilities can be too costly for many cleanup project proponents, a MUDS facility can help achieve the economy of scale needed to enable cleanups to proceed. In addition, it is more efficient to design, finance, build, operate, close, and monitor a few MUDS facilities than to do the same for numerous single-user facilities. For these reasons, at least one Puget Sound project proponent is preparing a draft EIS that includes a MUDS alternative - the East Waterway Deepening Project by the Port of Seattle and the Corps of Engineers (Martin 1999).

Feasibility

The analysis contained in this PEIS indicates that all the "Action" alternatives for <u>disposal</u> of contaminated sediment are technically feasible today. The conceptual MUDS facility designs presented and described in this PEIS can be modified to include site-specific considerations and built for effective long-term containment of sediment contaminants. For example, aquatic dikes can be engineered to withstand a certain level of seismic activity and prevent slow release of contaminants. Upland CDFs can be designed with liners to help collect and treat contaminants contained in leachate, although risks still remain. Furthermore, all disposal facility alternatives can be monitored to ensure contaminants are effectively confined. For example, there is ample national and regional experience with how to monitor the long-term stability of sediment caps. There is also an extensive body of knowledge on monitoring the effectiveness of solid waste landfill liners, as well as leachate collection and treatment systems, that can be applied to an upland CDF.

Disposal of contaminated sediment at existing solid waste landfills can be environmentally protective and address regional needs, but at the undesirable expense of losing capacity for disposal of municipal garbage. Current costs (dollars per cubic yard) for disposing of sediment in landfills is prohibitive to some, and disposal rates for such practice in the future is not guaranteed to be competitive with costs for disposal at a MUDS facility.

From a technical perspective, it is feasible for a private party to design and build a MUDS on private property. However, at least one previous attempt to build such a MUDS facility was unsuccessful, due in part to major liability concerns. These liability concerns will need to be resolved for this alternative to become a practical reality.

Large-scale, cost-competitive decontamination or treatment of contaminated sediment does not appear to be feasible today, but is very promising. Many conceptual treatment strategies and their technical feasibility have been proposed and investigated. Some technologies have proven to be effective in reducing or removing contaminants from sediment, but are not yet cost-competitive when operated on a pilot or commercial scale. Other approaches propose treating contaminated sediment using technology available for treating different raw materials or wastes on a commercial scale. Still others remain unsubstantiated from a technical perspective. Most decontamination or treatment processes result in usable products, by-products and wastes, some of which may not be publicly acceptable or easily disposed.

Although it appears that decontamination or treatment of sediment on a commercial scale is not yet feasible, there may be other factors that make this alternative as timely as building a MUDS (disposal) facility. These include a potentially greater public acceptance of a treatment facility, endangered species listings, political will, regulatory preference for reuse/recycling of materials, and the time required to obtain necessary facility permits.

Cost-Competitive

The cost to dispose of or treat contaminated sediment at a MUDS or multiuser sediment treatment facility must closely approximate that of existing disposal options. Although some degree of subsidization of disposal or treatment fees may be publicly acceptable, a MUDS facility must be cost-competitive or offer significant non-dollar advantages for it to be successful.

Although not all of the costs associated with building, operating, closing and monitoring a MUDS have been identified, and some cannot be quantified easily at a programmatic level, there appears to be overlap between the disposal cost projected for the three conceptually designed MUDS facilities and the existing alternatives (see Alternatives section of this summary). This indicates that all "Action" alternatives can be cost-competitive on a site-specific basis. In other words, a confined disposal facility can be designed for a specific location that will result in user costs for disposal that are competitive with, for example, disposal in existing solid waste landfills.

Impacts

The environmental impacts of building, and to a lesser extent operating a confined disposal or treatment facility are significant. Building a MUDS would effectively preclude 25 to 100 acres (or more) of aquatic or terrestrial habitat from other potentially beneficial land uses, in perpetuity or at least for many years. On-site and adjacent habitat - soil and water resources - could be impaired, with numerous consequences to flora and fauna. However, because of differences in sites and designs, a detailed evaluation of environmental impacts is difficult prior to the preparation of a site-specific EIS. In general, however, aquatic or nearshore MUDS facilities could result in short-term and long-term impacts to aquatic habitat and resources. Impacts from construction of an upland CDF would depend on many factors, but particularly the geophysical and biological characteristics of the site selected and its nearby surroundings. The likely impacts would be similar to ones expected for existing solid waste landfills, except for the impacts associated with return flows resulting from the dewatering of sediments. It is difficult to evaluate the environmental impacts resulting from decontamination or treatment of contaminated sediments because there are many strategies and technologies that might be involved; the impacts would be evaluated at the site-specific phase when more information on specific treatment technologies, wastes, and by-products is available. Any MUDS disposal or treatment facility would likely result in an increase in barge, train and/or truck traffic and associated air pollution and noise.

Not all of the potential impacts identified can be avoided. Nor can adequate mitigation be planned or implemented in all cases. However, many mitigation and management measures can be taken to avoid or greatly reduce possible impacts and/or compensate for those impacts.

Building one or more MUDS hastens the isolation and confinement of contaminated sediment from the healthy elements of the Puget Sound environment by facilitating sediment cleanup actions. This translates to a substantial reduction in the environmental impacts associated with "No Action", which derives from the current exposures of biota to surface sediment contaminants, contaminant transfers within food webs and exposure of humans to the biota.

Preferred Alternative

This is nothing in this PEIS that leads to the selection of a single preferred alternative for the disposal or treatment of contaminated sediments from Puget Sound at this time. The documented need for disposal and/or treatment capacity indicates that more than one location and type of facility may likely be required. If the MUDS Feasibility Study proceeds to a site-specific phase, then central Puget Sound appears to be the most logical geographic focus of initial siting efforts. Needing more than one location and facility design dictates that maximum flexibility be maintained in selecting both sites and alternatives. For example, the first MUDS site selected might only be suitable for a CAD facility. A second site might be amenable to both a nearshore and upland CDF. Another location might be suitable for development of a dewatering and decontamination/treatment facility. Or a nearshore site might only be suitable as a rehandling facility where contaminated sediment is dewatered and then transported to an existing landfill. Thus, although there is no preferred alternative, it is highly likely that the Combination Alternative is the most realistic eventuality. Over the next ten to twenty years, one could expect continued use of existing landfills, and establishment and use of at least a few of the following: a commercial dewatering facility, one or more MUDS facilities of different design, and a contaminated sediment treatment facility.

"No Action" is not considered an acceptable alternative. Although this alternative will continue to result in successful sediment cleanup actions, current disposal alternatives provide a lack of adequate disposal capacity that continues to impede the dredging of contaminated sediment for remediation, habitat restoration, channel/harbor maintenance and industrial development. No action will result in a reduction in capacity at solid waste landfills and lost opportunities to dispose of some contaminated sediments that need to be dredged.

Tradeoffs

On a site-specific basis, the advantages and disadvantages of each disposal or treatment alternative must be viewed in a context that considers the ability to meet regional disposal needs, environmental impacts, cost, irretrievable commitments of public resources, timing issues, policy and liability concerns, and public acceptability. Table S-2 summarizes some of the broader advantages, disadvantages, and areas of uncertainty for each alternative based on the information presented in this PEIS.

Table S-2. The Advantages and Disadvantages of Each Alternative.

Alternative	Potential Advantages	Potential Disadvantages	Uncertainty/Controversy
No Action	Less dredging and disturbance of contaminated sediments	Stalled cleanups/contaminated sediments remain exposed Only large entities address problem Potential proliferation of CDFs	Whether policy/regulatory solutions can address disadvantages
LBC/CAD	Effective containment Minimal rehandling Sediments remain saturated, anaerobic Few aesthetic impacts Relatively low cost	Some contaminant release during placement Siting may be difficult due to Puget Sound slopes/depths Requires highly coordinated and relatively costly monitoring/management Forecloses some future aquatic land use	Siting Use of State-owned Aquatic Land Tribal fishing rights Public acceptability
Nearshore CDF	Effective containment Sediments remain saturated, anaerobic Can provide public access, habitat as part of design Commercial/industrial land use following closure Use of contaminated sediment site for MUDS	Loss of nearshore aquatic habitat Uncontrolled pathway (bird/animal foraging) prior to final closure Aesthetic impacts (view, odor, noise) on shoreline Forecloses some future nearshore land use Relatively high cost	Siting Permitting/mitigation requirements Use of State-owned Aquatic Land Tribal fishing rights
Upland CDF	Effective containment No aquatic land or aquatic habitat impacts Potential abandoned property use Commercial or recreational land use following closure	Multiple rehandling and release opportunities Sediments dried and aerated (contaminants potentially mobilized) Aesthetic impacts (view, odor, noise) Siting of CDF and dewatering facility difficult due to real estate constraints Relatively high cost	Siting Public acceptability Permitting/mitigation requirements
Existing Landfills	Effective containment No aquatic land or aquatic habitat impacts Use of existing permitted facility No CDF design/permitting issues	Multiple rehandling and release opportunities Sediments dried and aerated (contaminants potentially mobilized) Uses disposal capacity targeted for municipal wastes Relatively high cost	Dewatering provided or project-by-project Exporting contaminants to other regions
Multiuser Access	Effective containment Proponent constructs, designs, and manages CDF	Timing relative to regional need Liability management	Project specific
Treament	Re-use/recycle Possible conversion of contaminants to inert forms No long-term commitment of land resources to contaminated sediment confinement function Public acceptability	Mobilization of contaminants and creation of waste side-streams Potential generation of more hazardous contaminants Not yet feasible in the region on a large scale	Research and development needed to determine feasibility in Puget Sound Site-specific processes and facility configuration not yet defined
Combinations	Effective containment Project specific Most flexible solution	Project specific Increased capacity	Project specific

Other Needs

Many additional issues need to be resolved prior to building a first MUDS facility. Some of these include:

- How to gain widespread public support
- How to proceed with a technically sound and publicly acceptable facility siting process
- How to finance the final design and construction of the facility
- Who owns/operates the facility
- How to implement meaningful Contingency Management Agreements (that include evaluation and operational procedures, an interagency oversight committee, etc.)
- Others